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# Measuring Fiscal Policy Spillovers in the Euro Area

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### Abstract

We study fiscal policy coordination and fiscal policy spillovers in Germany, France, Spain and Italy using a Time-Varying Coefficients VAR model for the period 1995-2014. While the four country-specific cycles share large commonalities, fiscal policy coordination across countries, measured as the time-varying correlation between government spending growth, is very low. Country-specific government spending shocks generate significant effects on the remaining countries. International spillovers are especially strong in the medium run and during the financial crisis. Also, we find heterogeneous and asymmetric response to spending across countries.

**Keywords:** Fiscal spillovers, government spending shock, time-varying coefficients VAR, Euro Area

Jel codes: C32, E32, E62

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# 1 Introduction.

The recent global crisis has revived the interest for fiscal policy and its role as a tool of economic boost (e.g. Blanchard and Leigh (2013), Mertens and Ravn (2014) and Auerbach and Gorodnichenko (2012)). In a time of financial distress, the debate among advocates of fiscal austerity and fiscal stimulus has been quite prolific, generating a vast amount of academic production. We refer the reader to Ramey (2011) for a recent survey of the literature.

Theoretical models have shown that monetary policy can hinder in the transmission of fiscal policy and ultimately offset its effects. Indeed, Fernández-Villaverde et al. (2015), Eggertsson (2011), Woodford (2011) and Christiano et al. (2011) agree on the fact that fiscal multipliers are higher when interest rates are constrained by the zero lower bound. On the same line, Hall (2009) shows that in a liquidity trap, multipliers can be larger if employment is responsive to demand. This conjecture, however, has not gone unchallenged. As an example, Ramey and Zubairy (2014) fail to find significant evidence of multipliers above average during the Great Recession. This gives a taste of how the debate is still fervent and far from being settled.

Other theoretical conditions that can amplify the effectiveness of government actions are summarized by Canova and Pappa (2011): high pricing frictions, strongly countercyclical markups and fiscal spending coming with provisions of future spending cuts. Similarly, Corsetti et al. (2010) support the notion that short term stimulus policies are most effective when coupled with medium term spending reversals.

On an empirical ground, scholars have been much concerned about estimating the size of fiscal multiplier. However, this is no easy task. The main challenges come from the endogeneity of government spending and the formation of expectations about future tax policies (Leeper et al. (2013)). To circumvent these problems, some studies have resorted to structural VARs (Mertens and Ravn (2014), Mountford and Uhlig (2009), Blanchard and Perotti (2002)), also in time varying frameworks (Kirchner et al. (2010); Pereira and Silva Lopes (2014)). Other empirical strategies rely on instrumenting fiscal spending with military expenditure (inter alia, Barro and Redlick (2009)).

Furthermore, the crisis has shown how interconnected the world is and how quickly downturns in a country can spread their contagion internationally. Notwithstanding this, little work is done on the cross-country effects of fiscal policy. Our work addressed this gap in the literature and it is aimed at shedding some light on spillovers effects in

the euro area.

This is especially interesting taken into consideration that EU monetary policy is common, markets are highly integrated, countries are institutionally bond but fiscal policy is not quite unified. Since the outbreak of the crisis, the idea of increasing fiscal coordination beyond the European Stability Mechanism has been a near-constant subject of political discussion. This is why it is important to testify the existence and quantify the amount of fiscal spillovers, in order to provide policymakers with robust evidence to drive the process of European integration.

However, as it is the case of fiscal multipliers, the current literature on fiscal spillover has not quite reached a consensus. Gros and Hobza (2001) do a review of result from different macro models and report how cross-country spillovers are indeed uncertain, both in sign and magnitude. For instance, Cwik and Wieland (2011) present five DSGE new Keynesian models calibrated to the euro area, finding that spillovers between countries are negligible or even negative.

There are though theoretical reasons lending support to the existence of fiscal spillover. Policy shocks can propagate via the demand channel, when domestic demand affects foreign demand too. This can happen due to inflationary pressure in a country shifting trade balances across EU states. Also, spillovers can act through financial markets, when the excessive borrowing in the source country increases the risk premium of foreign economies. Even if there is no explicit bail out rule, markets might expect members states to be somehow liable for their neighbors sovereign debt, thus associating higher risk premium to higher risk of financial of contagion.

Our work thus contributes to the ongoing discussion, presenting empirical evidence of the cross border effects of fiscal policy across four countries in the Euro zone, namely Italy, France, Germany and Spain. Using a Time-Varying Coefficients VAR model we find that economic cycles are correlated, underlining the interdependence across member states. Furthermore, even in absence of explicit fiscal coordination, we find that shifts in government spending cause international spillovers, with heterogeneous signs and magnitudes across countries.

We include time variation in the analysis, given that Auerbach and Gorodnichenko (2013) suggest that spillovers vary across the business cycle, showing stronger effects in recessions. On the contrary, Faccini et al. (2016) find limited state dependence in the international transmission of fiscal policy. However, our sample spanning from 1995

to 2014, includes institutional as well as financial aspects and naturally calls for a time-varying setting. Indeed, we found that spillovers are especially sizable in the medium run and during the financial crisis. Our empirical approach relies on estimating the effects of shocks in one source country on all the other country's output. This has the twofold advantage of providing with a transparent and straightforward interpretation while allowing for heterogeneity in the transmission across member states.

The remainder of the paper is organized as follows: section 2 presents the model, the identification strategy and the estimation approach, of time-varying impulse responses and second moments. Then, section 3 reports the empirical evidence on cross-border spillovers across the countries at hand. Finally, section 4 summarizes and concludes.

## 2 Econometric Approach.

### 2.1 The Model.

We perform the analysis using a structural time-varying VAR model with stochastic volatility (see Primiceri (2005)). With the model we compute time-varying second moments to measure fiscal policy coordination and identify a government spending shock using zero restrictions. Let  $y_t$  be a  $n$ -dimensional vector of macroeconomic variables. We assume that

$$y_t = A_{0,t} + A_{1,t}y_{t-1} + \dots + A_{p,t}y_{t-p} + \varepsilon_t \quad (1)$$

where  $\varepsilon_t$  is a  $n \times 1$  Gaussian white noise vector with time-varying covariance matrix  $\Sigma_t$ ,  $A_{0,t}$  is a  $n \times 1$  vector of time-varying coefficients and  $A_{i,t}$  are  $n \times n$  matrices of time-varying coefficients,  $i = 1, \dots, p$ . Let us define  $A_t = [A_{1,t}, A_{2,t}, \dots, A_{p,t}]$ , and  $\theta_t = \text{vec}([A_{0,t} \ A_t]')$ , where  $\text{vec}(\cdot)$  is the stacking column operator. We assume that the VAR coefficients evolve as

$$\theta_t = \theta_{t-1} + \omega_t \quad (2)$$

where  $\omega_t$  is a Gaussian white noise vector with covariance  $\Omega$ .

Let us now consider the following decomposition of the innovation covariance:  $\Sigma_t = F_t D_t F_t'$ , where  $F_t$  is a lower triangular matrix with ones on the main diagonal and  $D_t$  a diagonal matrix. Let  $\sigma_t$  be a column vector containing the diagonal elements of  $D_t^{1/2}$  and let  $\phi_{i,t}$ ,  $i = 1, \dots, 4$ , be a column vector containing the first  $i$  elements of the  $(i+1)$ -th

row of  $F_t^{-1}$ . In addition we assume that the states evolve according to

$$\log \sigma_t = \log \sigma_{t-1} + \xi_t \quad (3)$$

$$\phi_{i,t} = \phi_{i,t-1} + \psi_{i,t} \quad (4)$$

where  $\xi_t$  and  $\psi_{i,t}$  are Gaussian white noise vectors with zero mean and variance  $\Xi$  and  $\Psi_i$  respectively. Let  $\phi_t = [\phi'_{1,t}, \dots, \phi'_{n-1,t}]$ ,  $\psi_t = [\psi'_{1,t}, \dots, \psi'_{n-1,t}]$  and let  $\Psi$  be the covariance matrix of  $\psi_t$ . We assume that  $\psi_{i,t}$  and  $\psi_{j,t}$  are uncorrelated for  $j \neq i$  and that  $\xi_t, \psi_t, \omega_t, \varepsilon_t$  are mutually uncorrelated.

## 2.2 Time-varying second moments.

The time-varying second moments of  $y_t$ , in particular correlations, can be studied using the “approximate” MA representation

$$y_t = \mu_t + C_t(L)\varepsilon_{t-k} \quad (5)$$

where  $C_t(L) = \sum_{k=0}^{\infty} C_{k,t}L^k$ ,  $C_{0,t} = I$ ,  $C_{k,t} = \mathcal{S}_{n,n}(\mathbf{A}_t^k)$ ,  $\mathbf{A}_t = \begin{pmatrix} I_{n(p-1)} & A_t \\ & 0_{n(p-1),n} \end{pmatrix}$ ,  $A_t = [A_{1t} \dots A_{pt}]$ , and  $\mathcal{S}_{n,n}(X)$  is a function selecting the first  $n$  rows and  $n$  columns of the matrix  $X$ . The time-varying covariance matrix of  $y_{it}$  is given by

$$V_t = \sum_{k=0}^{\infty} C_{k,t} \Sigma_t C'_{k,t}.$$

The time-varying correlation between variable  $j$  and  $i$  is simply given by

$$\rho_t^{i,j} = \frac{V_{t,ji}}{\sqrt{V_{t,jj}V_{t,ii}}} \quad (6)$$

where  $V_{t,ji}$  denotes the element  $j, i$  of  $V_t$ .

## 2.3 Identification.

One of the main focus of the paper is the investigation of the existence of fiscal policy spillovers across the four countries. Let  $y_t = [g_{jt} \ g_{it} \ x_{jt} \ x_{it}]'$  where  $g_{jt}$  and  $g_{it}$  is government spending in country  $j$  and  $i$  and  $x_{jt}$  and  $x_{it}$  are GDP growth in country  $j$  and  $i$ . We consider six different models with all possible combinations of countries. A government spending shock in country  $i$  is identified following Blanchard and Perotti (2002). The shock is the only shock orthogonal to government spending in country  $j$  which has a non-zero contemporaneous effect on government spending in country  $i$ . Orthogonality

to foreign spending is important to “control” for fiscal policy in other countries. Identification is implemented as follows. Let  $S_t$  be the Cholesky factor of  $\Sigma_t$  ( $S_t S_t' = \Sigma_t$ ). Postmultiply the reduced form impulse response functions  $B_t(L) = C_t(L)S_t$ . The government spending shock so that the second column of  $B_t(L)$  represents the effects of the government spending. The shock is the second shock in the vector  $e_t = S_t^{-1}\varepsilon_t$ .

## 2.4 Specification and estimation.

Estimation is standard and is done along the lines of Galí and Gambetti (2015)<sup>1</sup>. Below we discuss some aspects of the prior densities calibration. We use one lag. As it is standard in the literature, we assume that  $\Omega$ ,  $\Xi$ ,  $\Psi$ ,  $\theta_0$ ,  $\phi_0$  and  $\log \sigma_0$ , are all independent. Let  $W(S, d)$  denote a Wishart distribution with scale matrix  $S$  and degrees of freedom  $d$ , we assume:

$$\begin{aligned}\theta_0 &\sim N(\hat{\theta}, \hat{V}_\theta) \\ \log \sigma_0 &\sim N(\log \hat{\sigma}_0, I_n) \\ \phi_{i0} &\sim N(\hat{\phi}_i, \hat{V}_{\phi_i}) \\ \Omega^{-1} &\sim W(\underline{\Omega}^{-1}, \underline{\rho}_1) \\ \Xi^{-1} &\sim W(\underline{\Xi}^{-1}, \underline{\rho}_2) \\ \Psi_i^{-1} &\sim W(\underline{\Psi}_i^{-1}, \underline{\rho}_{3i})\end{aligned}$$

Scale matrices are parametrized as follows:  $\underline{\Omega} = \underline{\rho}_1(\lambda_1 \hat{V}_\theta)$ ,  $\underline{\Xi} = \underline{\rho}_2(\lambda_2 I_n)$  and  $\underline{\Psi}_i = \underline{\rho}_{3i}(\lambda_3 \hat{V}_{\phi_i})$ . The degrees of freedom  $\underline{\rho}_1$  and  $\underline{\rho}_2$  are equal to the number of rows  $\underline{\Omega}^{-1}$  and  $I_n$  plus one respectively and  $\underline{\rho}_{3i}$  is  $i+1$  for  $i = 1, \dots, n-1$ . The parameters  $\hat{\phi}_i, \hat{V}_{\phi_i}, \log \hat{\sigma}_0, \hat{\theta}, \hat{V}_\theta$  are imposed equal to the OLS estimates of obtained from a time invariant VAR estimated for the full sample. Finally we assume  $\lambda_1 = 0.0005$ ,  $\lambda_2 = 0.01$  and  $\lambda_3 = 0.01$ . The choice of the  $\lambda$ 's is relatively conservative especially for  $\lambda_1$  and is motivated by the fact that we want time variations not to be inflated by our priors. The posterior distribution of the parameters is obtained with the Gibbs sampler. See the online appendix of Galí and Gambetti (2015) for the details of the of the seven steps involved in the algorithm.

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<sup>1</sup>For details about the estimation we refer the reader to the online appendix of Galí and Gambetti (2015).

### 3 Evidence.

Here we present and discuss the main results of the paper, divided in two main groups. First, we discuss evidence about fiscal policy and coordination and business cycle synchronization. Second we present results about fiscal policy spillovers.

#### 3.1 Cycles and Fiscal policy coordination.

To study fiscal policy coordination we use model (1) where  $y_t$  is a vector including the series of real government spending for the four countries. We estimate the model and compute the time varying correlations (6). The use of time varying techniques allows to investigate the evolution of the model parameters, which is especially interesting in a sample featuring financial distress and regime switching. Thus we assess the time evolution of real GDP and governments spending growth, both in terms of cross-country correlations and of variances. We find evidence of strong correlation of the business cycles. Conversely, we observe no cross-country synchronization in fiscal spending. Also, we find heterogeneity in terms of variance, with similar patterns in France and Germany but distinctive behaviors in Spain and Italy.

Figure 1 reports the time varying correlations for the GDP growth of the four countries. The solid lines depicts the median draw from the posterior distribution while the grey areas represent the 68% confidence bands. As emerges from the picture, cross-country correlations in GDP growth is high and roughly stable throughout the sample period. This implies that business cycle fluctuations are very much synchronized across countries.

Also, notice how correlations increase during the global financial crisis, peaking around 2009. This mirrors how the economic slowdown hit all the countries pervasively, provoking parallel recessions. Only Spain and Italy maintained a stable time varying correlation, showing that their GDP performance has similar faith both in good and in bad times. Indeed, especially in the cross comparison with France and Germany, we observe similar pattern of convergence during the recession period followed by a drastic reduction in correlations after 2010. This latter drop might be explained by a different pace of recovery between the peripheral and core countries of the sample.

Figure 2 plots the time varying variance of GDP growth. The series differ in magnitude, with higher values in Italy and Germany. However, they follow identical dynamics. On the one hand, we observe a first spike around 1999, which coincides with the intro-



duction of the monetary union and the common currency. This advocates in favor of our choice of a time varying model, that spots and controls for regime switches. On the other hand, the maximal peak is to be found a decade later in correspondence of the global recession. The financial turmoil spread uncertainty across borders, provoking a steep increase in the variance of GDP growth. Such trend is reverted at the end of the sample, where the progressive economic recovery shrunk the variances back to their pre-crisis levels.

If on the one hand, output growth is highly synchronized across countries (also in terms of uncertainty), on the other hand we do not observe any co-movements in fiscal policy. Figure 3 displays the time-varying correlations of government spending across member states. Clearly, correlations are largely non significant, mirroring the absence of coordinated fiscal spending across states. The only exception the Italian-Spanish case, whose estimates are positive, even if very low. Once more we find higher affinity within the peripheral states and larger heterogeneity with the core countries.

Notice for instance the case of France, whose point estimates suggest opposite reactions to spending in other countries. Especially when coupled with Germany, we observe persistently negative correlations, significant at least in the initial part of the sample. If anything, it seems that there is a counter reaction rather than a coordination of spending among the two countries. This suggest that French aversion for German fiscal management may date older than the 2012 elections, in which the winning party vowed to break the austerity measures sweeping Europe. In fact, we do not observe much discontinuity in the correlations before and after the Socialist party came in office.

Notwithstanding the lack of coordination, France and Germany show quite similar features regarding second moments. Figure 4 plots the time-varying variance of government spending growth. We can see that both France and Germany present a decreasing trend, with confidence bands shrinking towards the recent part of the sample. This drop in variance could be attributable to a reduction of the the discretionary part of fiscal policy, which translates into a limit to governments' actions and to smaller swings in spending. Also, the time-varying variance has spikes in 1999 and in 2009, suggesting that regime changes and periods of economical distress take their toll on fiscal spending too.

Moreover, Italy and Spain display a completely *sui generis* behavior in terms of variance. Italy presents relatively constant estimates, inflating in 2000-2004 but stabilizing

at a roughly fixed value. Spain on his side, shows an overall upwards trend, especially from 2011 when the popular party come to power. If is not coincidental, the recent increase in volatility can be read as the government need to resort to larger spending swings to achieve its program of cutting deficit, recapitalizing banks and promoting labor market reforms.

### **3.2 Fiscal spillovers in EU countries.**

We identify a government spending shock in each country via timing restrictions. On impact, a policy shock in country  $i$  is constrained to be orthogonal to spending in country  $j$ . In this fashion, structural disturbances are cleaned out of contemporaneous policy co-movements and represent purely non-coordinated domestic shocks. Notice that we do not impose restriction on output growth. In fact, a policy shift can redirect consumers towards national or foreign produced goods, with consequent adjustment of the trade balance, and direct effect on output growth.

The mechanism of transmission is posited in business-cycle models, as in Chari et al. (2002) and Corsetti et al. (2010) among others, even if the magnitude and sign of spillovers greatly depend on calibration and the debate on overall policy effect is far from being settled. In a nut shell, an exogenous increase of government spending can affect other countries via the trade channel. In fact, a fiscal stimulus can ease market frictions and benefit foreign output via increased demand for imports. However, there are also forces counteracting positive spillovers effects. Higher demand puts pressure on output gap and inflation. This translates into an increase in the long rate, which in turns dampens consumption. Such effect is amplified especially when spending is debt-financed and the country has already an high burden of public debt.

Furthermore, Corsetti et al. (2010) show that spillovers effect depend on whether fiscal policy is financed only with taxes or it is coupled with a credible medium-term consolidation plan. Their results point out that coordinated spending reversal reduce fluctuations in the long rates, thus easing the trade off between demand for output and crowding out of consumption and investment.

Our paper contributes to the ongoing discussion by presenting empirical insights on international spillovers effects in a sample of European countries. Given the mixed evidence inherited from theory, it comes as no surprise that we obtain heterogeneous results, both in term of signs and magnitudes.

A summary of the estimated spillover effects is presented in Table 1. It reports the average of cumulative percentage effect on GDP re-scaled by the average of cumulative percentage effect on government spending of the country where the shock takes place. In simple words, we compute, over 4 and 12 horizons, how much variation in GDP relative to spending is implied by an exogenous fiscal shock. Therefore these ratios can be interpreted as mean spillover effects across countries.

A first result is that, with few exception, spillovers are larger in the medium run. That is, wide swings in domestic spending are associated to moderate reactions of foreign output within the first year. Conversely, when we expand the analysis to 12 quarters, we observe spillover ratios that are as high as twice their short run value. We can read this result in light of the lack of coordination of fiscal policy. Without synchronization, there is few simultaneous contagions between neighbor countries and spillovers take the form of delayed demand and trade adjustments.

Once we have established that spillovers peak in the medium run, it is interesting to assess which historical moment features the stronger cross-country contagion. Table 2 contains the results of this exercise, reporting the dates of maximal spillovers, measured in terms of effects on GDP within the first three years after the shock. The interesting results is that higher spillovers are concentrated in the 2008-2010 period. This points to the fact that global distress amplifies cross-border effects, making countries more sensitive to their partners domestic policies. Therefore, especially in harsh times, there might be space for fruitful fiscal coordination, which is not observed in the data so far.

Next, to detail the consequences of spillovers of each country, Figure 6 to Figure 9 present a battery of time varying impulse responses. The panels gather the effects of a spending shock in a specific country after zero, four and eight quarters. Each subplot displays the time evolution of such effects. Put it differently, for each  $t$  in the sample range, we plot the (median posterior) impulse response at a fixed horizon  $k$ . The shaded area represent conventional 68% confidence bands. Broadly speaking, we observe that domestic effects of government spending are positive, even if non significant for France and Spain - questioning the overall effectiveness of their fiscal strategy. As regards spillovers, we have heterogeneous results, both in terms of significance and magnitude. Therefore, we review each case individually.

Starting with Figure 6, we observe how a spending shock in France has positive and significant effects of the GDP of Germany and Spain (while it falls short in affect-

ing Italy). This result stands out, being France the only observation whose spending is negatively correlated with the remaining countries. In a sense France is the least “coordinated” and at the same time it is the one with stronger cross-border spillovers. Observe, for instance the positive effects on Spanish GDP, which - as discussed above - have higher and more significant effects in the medium run. Furthermore the median estimates peak in 2008, confirming the interwoven fate of France and its southern neighbor in the crisis periods. As regards the French-German spillovers, we observe an interesting change in timing. Up to 2004, there was virtually no effect on impact, while in the medium run we had stable and significant estimates. From 2004 the situation is reversed with sizable effects happening only contemporaneously.

Figure 7 reports results for Germany. Clearly, fiscal shocks have positive effects domestically for all the displayed horizons. However, starting from the financial crisis, an increased variance of the estimates made it harder to read these results. Similar conclusions apply to spillovers on Italy, which are positive and stable, but non strongly significant after 2006. What is more surprising is the null effects over France, which brings forward the empirical fact that spillovers are non necessarily symmetrical across borders. Somehow less surprising is the lack of German-Spanish effects. Indeed, we saw that Spain and Germany are the two countries with weakest correlations both in terms of cycles and in terms of spending, and it comes as no surprise that spillovers only have a limited scope.

As regards Spain, responses are displayed in Figure 8. The majority of the international effects of Spanish spending are non significant on other countries, with exception of Germany. Curiously, an expansionary policy shock has persistently negative effects on German output. This singularity in the data might be the reflection of a consumption crowding out which more than compensates the positive demand spilled over. Once more, we observe asymmetric effects across countries.

Finally, Italy is reported in Figure 9, and has small but generally non-zero effects on the other countries. The difference is that spillovers on France and Germany are mostly significant at intermediate horizons, while the bulk of the transmission with Spain happens on impact, especially from the financial crisis onward. Furthermore, Italy displays positive domestic response to fiscal spending, peaking during the crisis period. This replicates closely the behavior observed in Germany, and shade some optimistic light on the positive scope of fiscal policy as a mean of economic stimulus.

## 4 Conclusions.

In this paper we present empirical evidence on fiscal spillovers for a set of European countries - namely France, Spain, Germany and Italy - over the last two decades.

To attack the issue we setup a time varying VAR for GDP and government spending growth. This has a twofold advantage. On the one hand it is especially fit in periods with regime switching and global instability. On the other hand, it allows to explore the time change of the parameters and better understand the evolution of structural dynamics among the countries.

Identification is reached via Cholesky restrictions. More in detail, we impose that a fiscal shock in one country is uncorrelated on impact with foreign spending. This is enough to ensure that we are extracting purely domestic fiscal disturbances. Also, we leave the response of GDP growth unrestricted, since they channel spillovers via the trading balance.

The main results of the empirical analysis are grouped in two blocks. First, we present time varying correlations and variances of both the GDP and the spending growth rates. Then, we explore the role of fiscal spillovers, using impulse responses from the identified shocks.

A first result in the data is that the four countries have very much synchronized business cycles, whose variance peaks in moments of regime switch (introduction of the euro) or of economic distress (global financial crisis). Conversely, we observe a complete lack of fiscal coordination, both in terms of co-movements and of second moments. Only Spain and Italy display some positive, but very small, spending correlation.

As regards spillovers, we exploit the impulse responses to compute multipliers as the ratio of (cumulative) variation in GDP relative to spending. We find that spillovers have higher strength in the medium run, reaching up to twice the impact effects after 12 quarters. Also, we show that spillovers are maximal during the crisis period. This paves the way of the debate on gains of fiscal coordination, especially in averse times, which we leave for future research.

Finally, we present evidence of heterogeneous responses to fiscal shocks across countries. We observe mixed evidence in term of sign, magnitudes and significance, with France and Italy affecting nearly all the others countries and Spain displaying even negative effects on Germany. This leads us to the conclusion that with uncoordinated fiscal spending spillovers do not act symmetrically and are not always significant nor benign.

This work want to contribute to the ongoing discussion on the role and benefits of fiscal stimulus, especially in periods of global turmoil. It might be interesting to expand the analysis to include a wider range of macroeconomic indicators, for instance interest rates or consumption growth. This might help disentangling details of the transmission mechanism, such as crowding out of consumption or inflationary pressure. This, and other correlated issues are left to future research.

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## Tables.

	Shock France		Shock Germany		Shock Spain		Shock Italy	
	1 year	3 years	1 year	3 years	1 year	3 years	1 year	3 years
France	--	--	0.0369	0.0606	0.0100	0.0266	0.1168	0.1684
Germany	0.3117	0.3941	--	--	-0.1825	-0.1901	0.0995	0.1888
Spain	0.3203	0.6466	-0.0080	-0.0374	--	--	0.0884	0.1507
Italy	-0.0172	0.1332	0.1975	0.2313	-0.0028	0.0529	--	--

Table 1: Spillover effects. The numbers represent the average (over draws and over time) cumulated percentage effect on GDP in the four countries in the first 4 quarters and 12 quarters, rescaled by the average (over draws and over time) cumulated percentage effect on the government spending variable of the country where the shock takes place.

	Shock France	Shock Germany	Shock Spain	Shock Italy
France	--	2001:Q2	1996:Q2	2008:Q3
Germany	2009:Q2	--	2011:Q4	2008:Q3
Spain	2008:Q3	2000:Q2	--	2009:Q3
Italy	2008:Q2	2008:Q4	2011:Q4	--

Table 2: Dates of maximal spillover effects considering the effects on GDP within the first three years after the shock. The cumulated effects of GDP are divided by the cumulated effects on the government spending variable of the country where the effects take place.

## Figures.

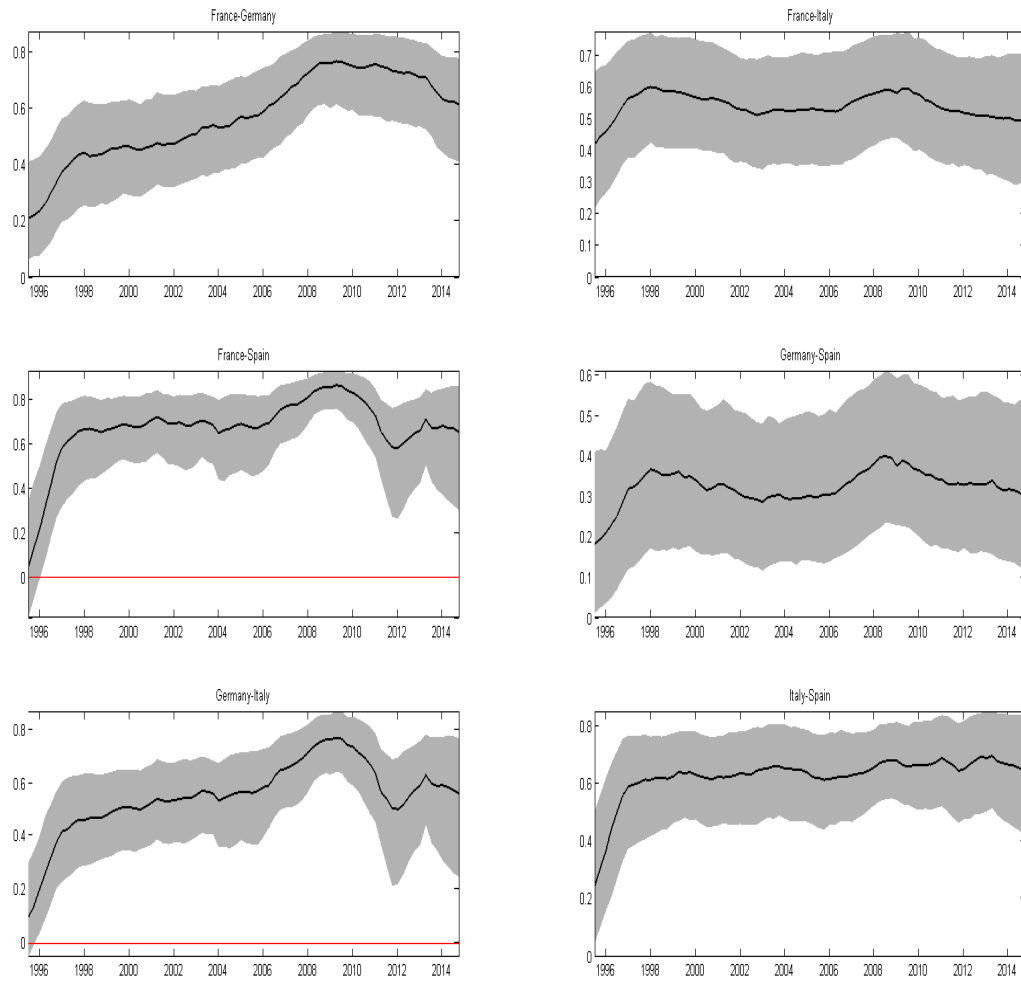


Figure 1: time-varying correlations of GDP growth across countries. Solid line posterior median, grey area 68% confidence bands.

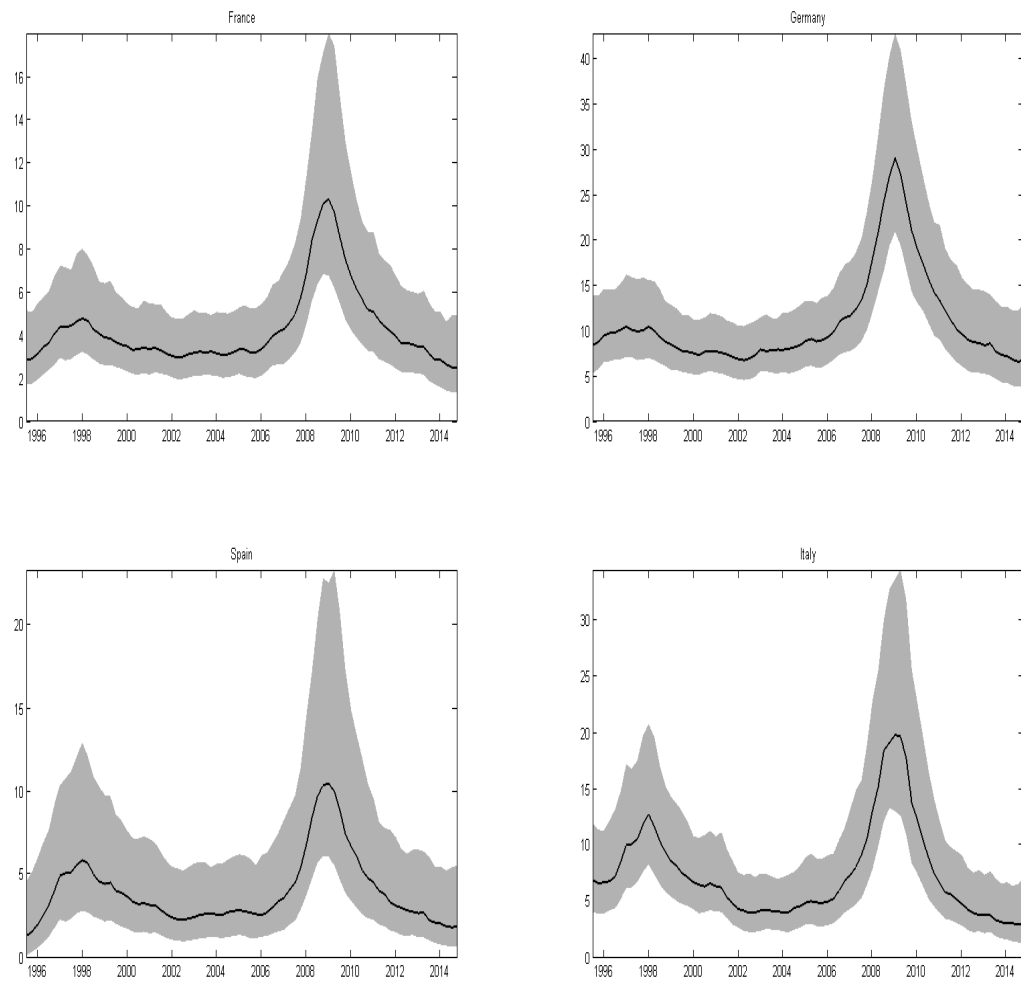


Figure 2: time-varying variance GDP. Solid line posterior median, grey area 68% confidence bands.

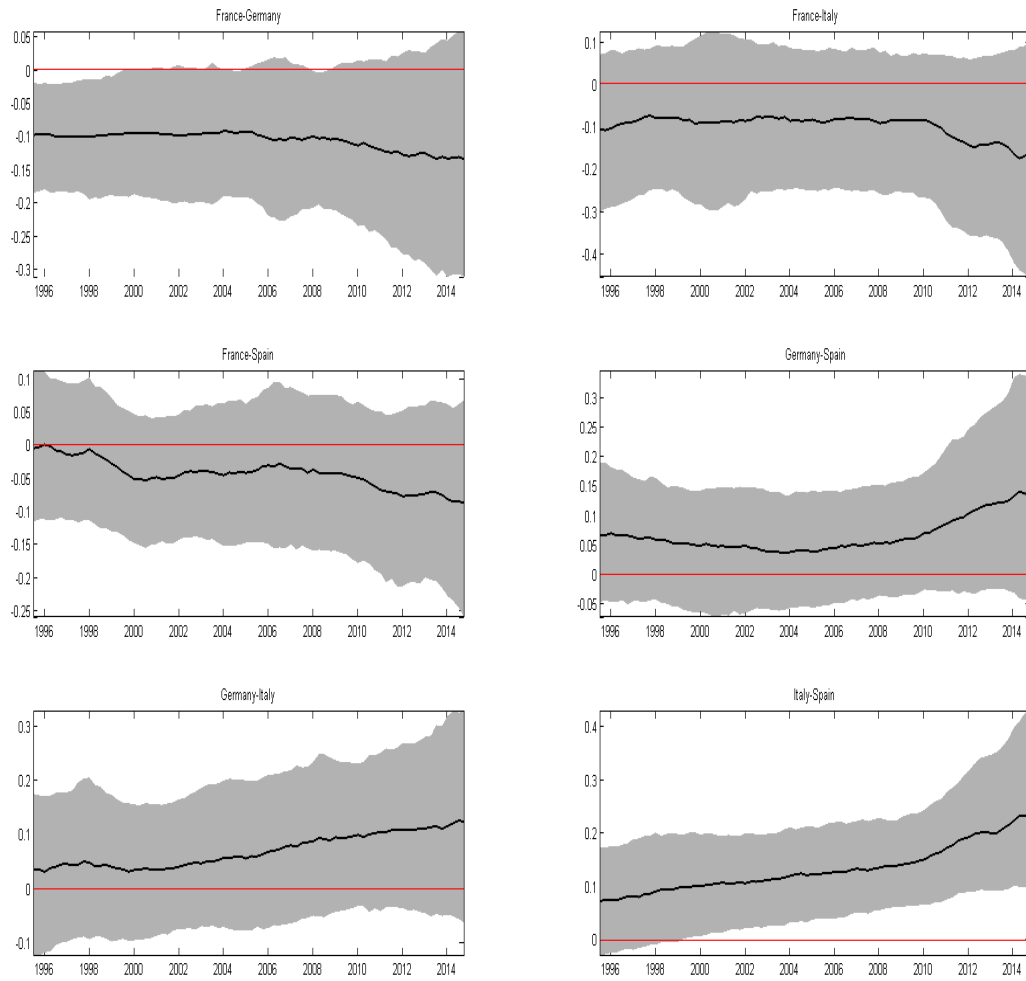


Figure 3: time-varying correlations of government spending growth across countries.  
Solid line posterior median, grey area 68% confidence bands.

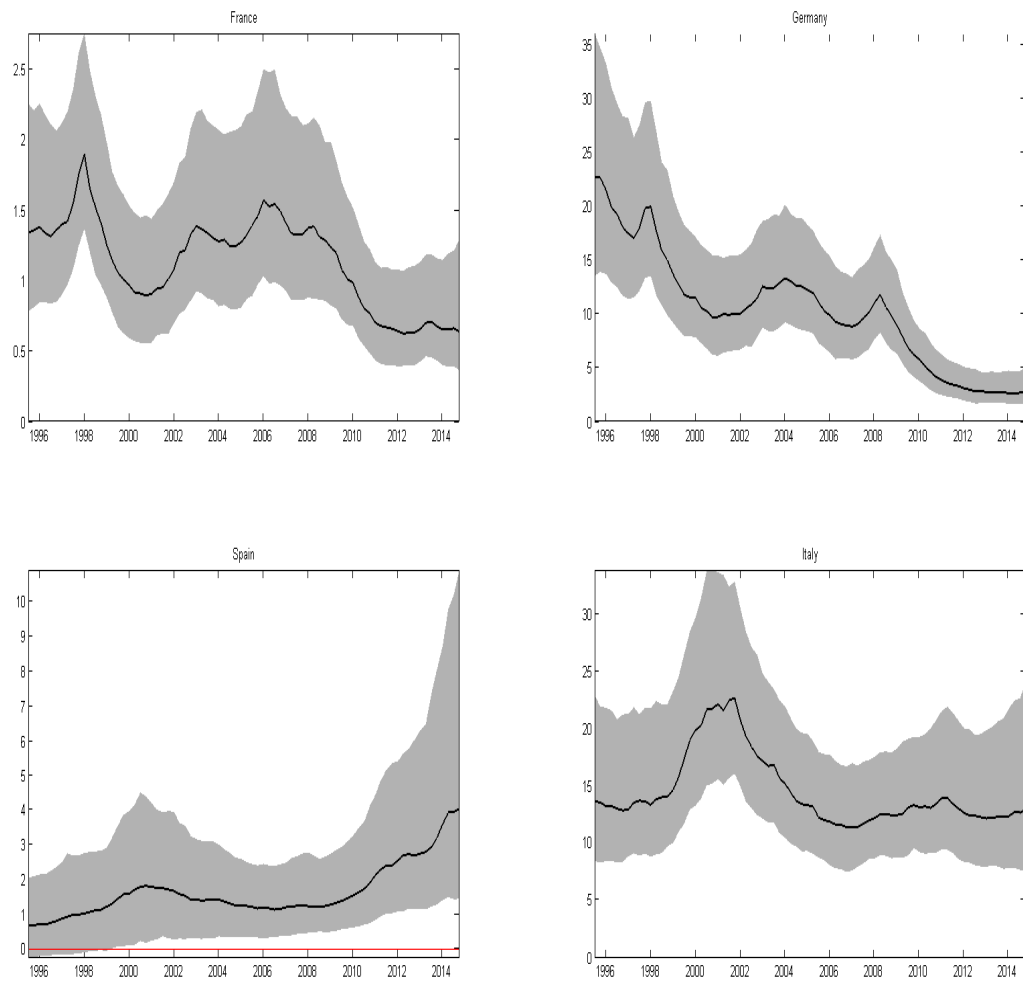


Figure 4: time-varying variance government spending. Solid line posterior median, grey area 68% confidence bands.

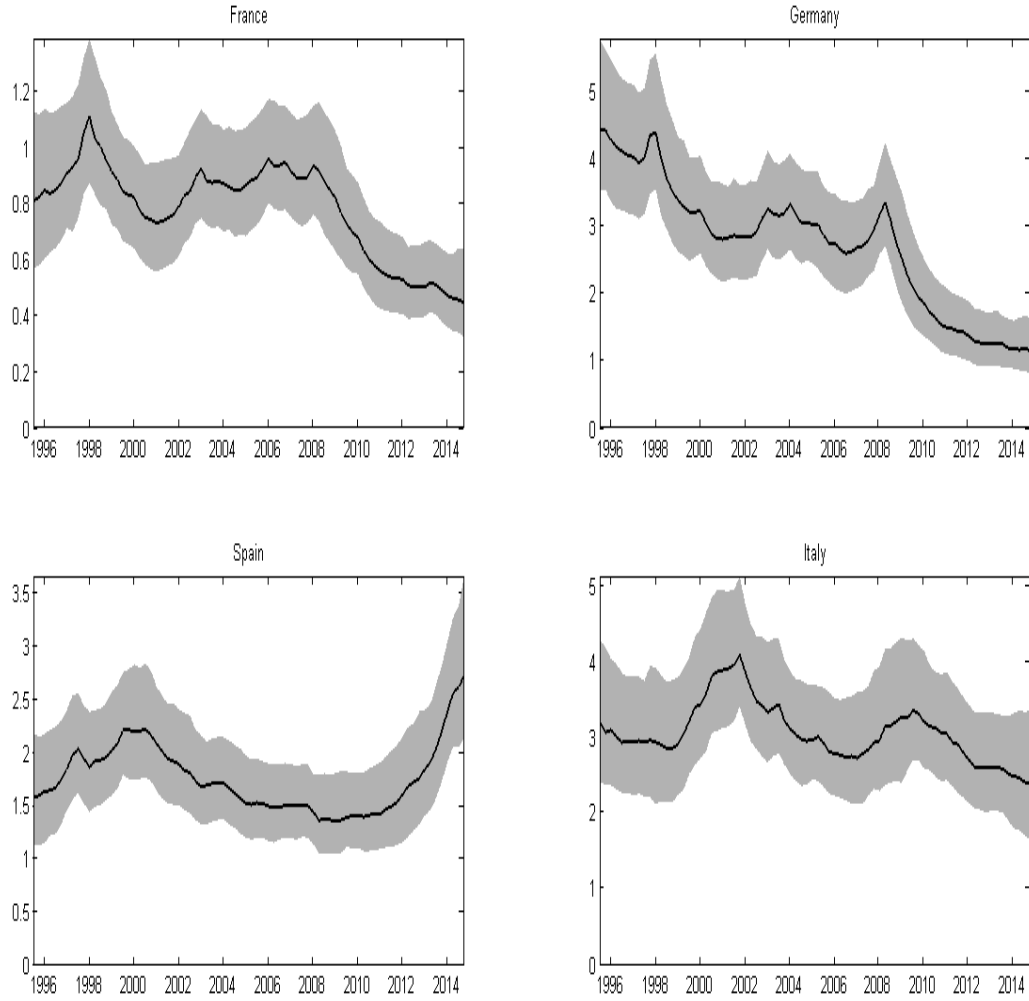


Figure 5: time-varying standard deviation of the government spending shock. The standard deviation is estimated by normalizing the effect of the shock on government spending of the home country equal to one. Solid line posterior median, grey area 68% confidence bands.

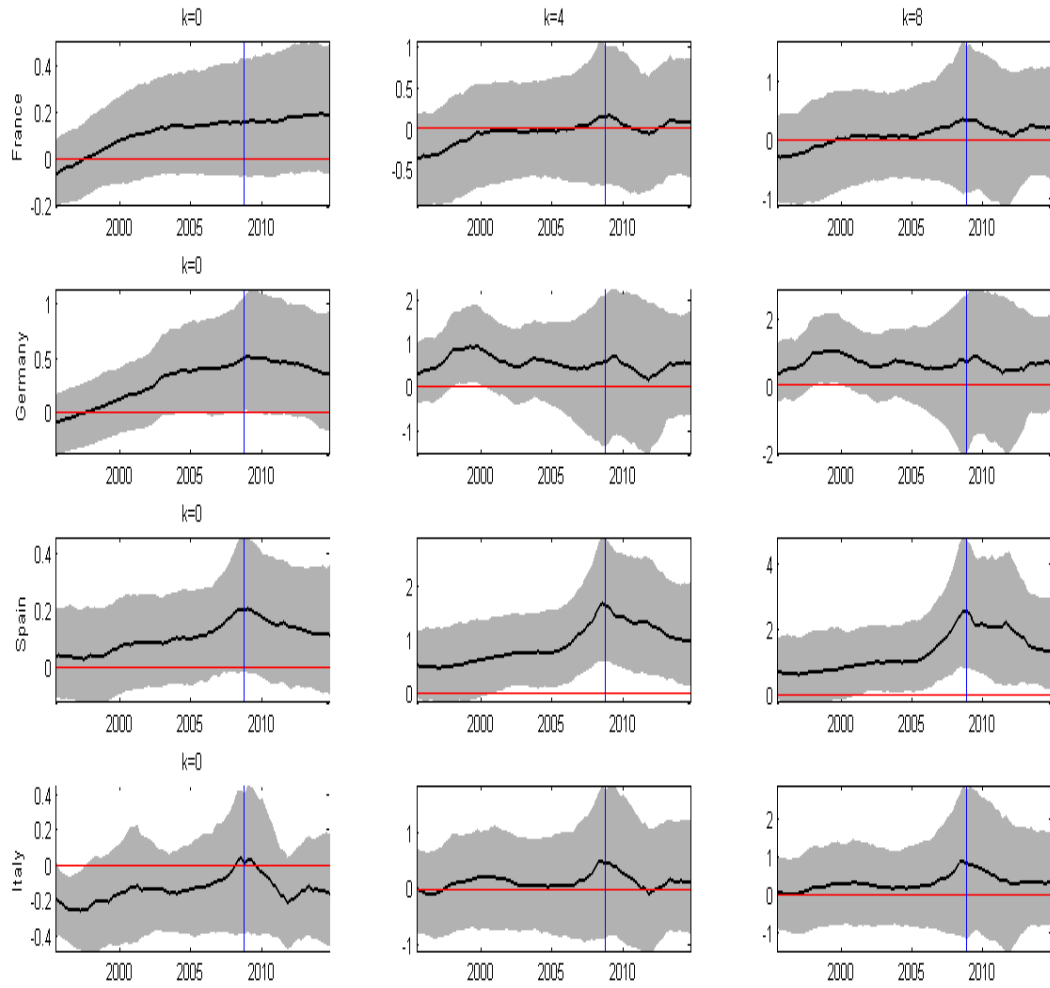


Figure 6: impulse response functions to a government spending shock in France.

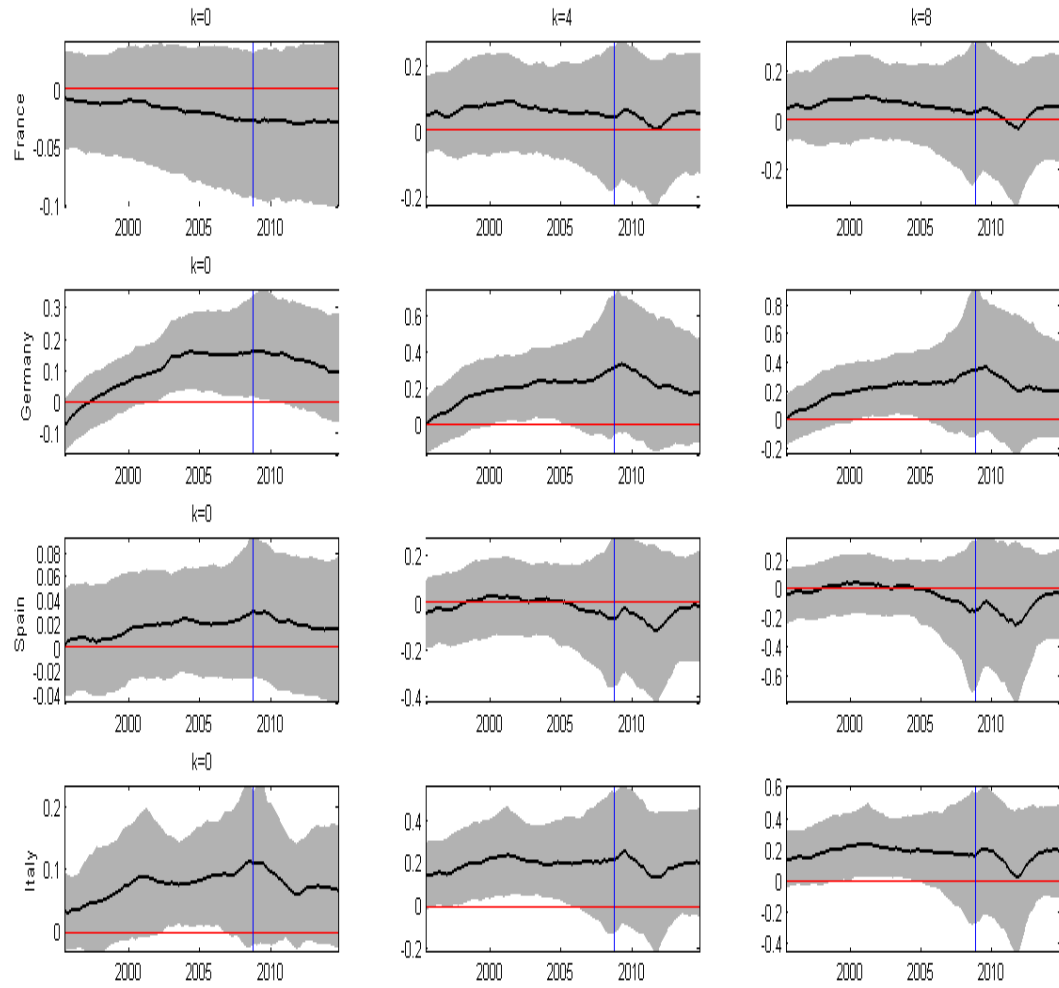


Figure 7: impulse response functions to a government spending shock in Germany.



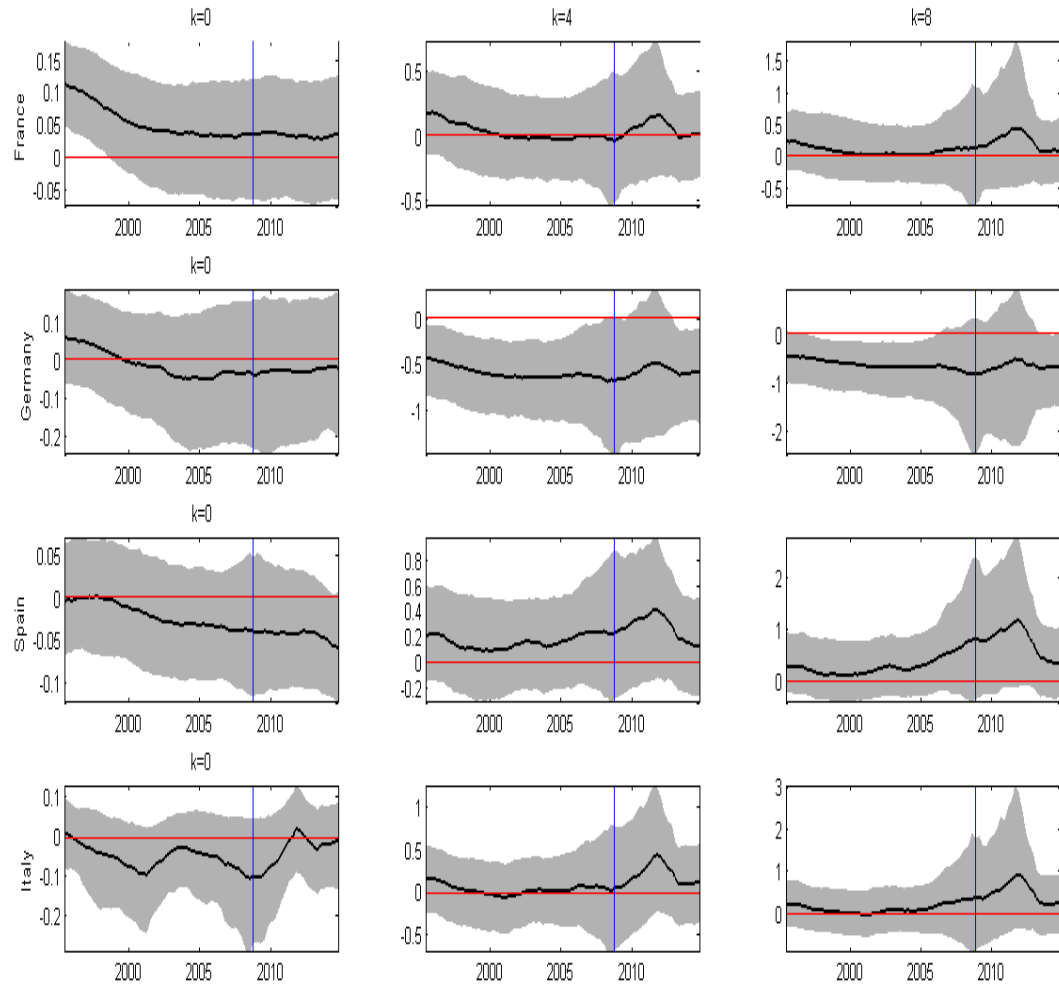


Figure 8: impulse response functions to a government spending shock in Spain.

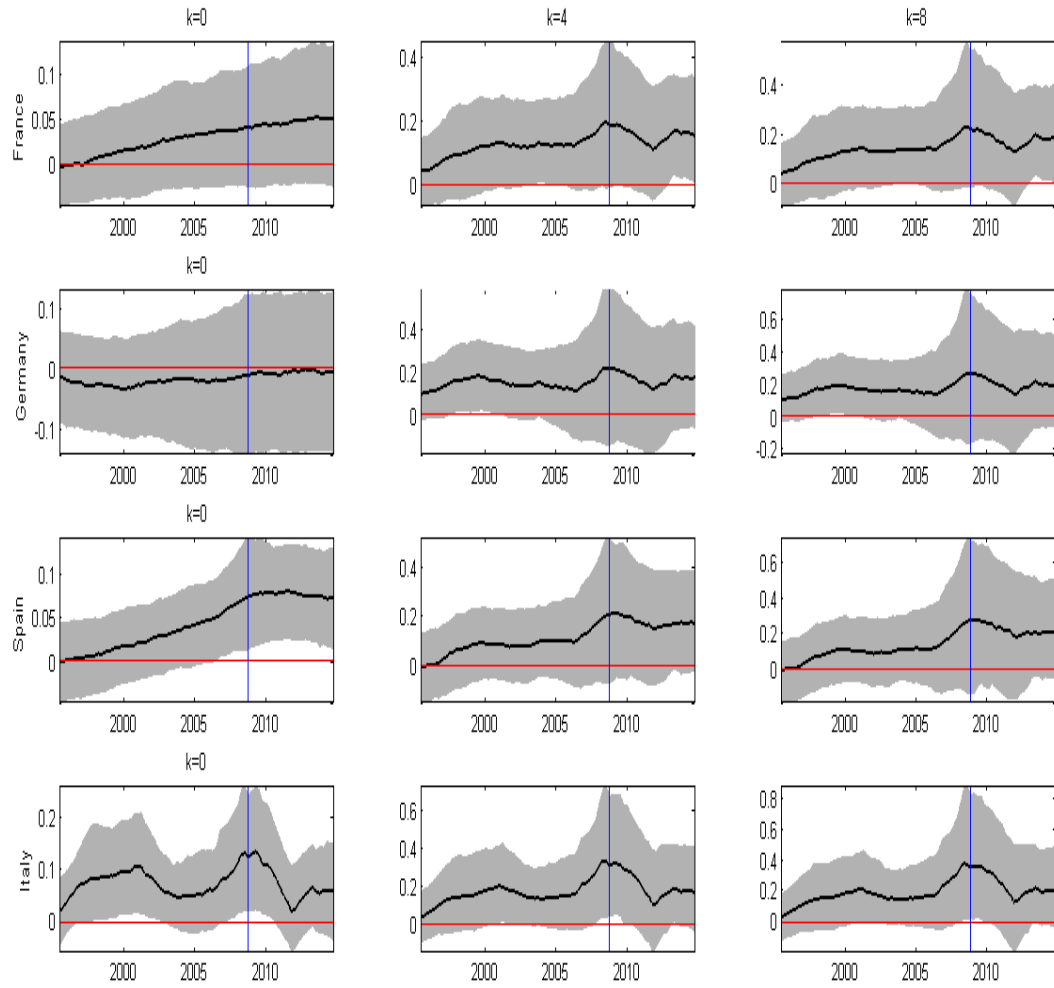


Figure 9: impulse response functions to a government spending shock in Italy.